MMS ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

Region: Alaska

Planning Areas: Beaufort Sea

Title: Idealized Process Model Studies of Circulation in the Landfast Ice Zone of the Alaskan Beaufort Sea (93-48-65)

Total Cost: $77,171 **Period of Performance:** FY 2006-2009

Conducting Organization: CMI, UAF

MMS Contact: Chief, Alaska Environmental Studies Section

MMS Information Needs to be Addressed: This study responds to a weakness in our understanding of first order physics of circulation along the landfast ice edge that was identified in the MMS Beaufort Sea Physical Oceanography Workshop and in prior MMS under-ice, nearshore current measurements. The information gained will improve our circulation and oil spill trajectory models used in pre-lease Beaufort Sea environmental assessments and post-lease evaluation of oil spill contingency plans.

Description:
Background Winds and river runoff influence the dynamics and circulation pathways over the innermost portion (water depths ~<20 m) of most continental shelves. While this is true for Arctic shelves as well, the effects of wind stress and buoyancy are substantially modulated by the annual freeze/thaw cycle, which controls the phasing and duration of the landfast ice season and river discharge. Because much of our understanding of shelf dynamics derives from studies on ice-free shelves, it is not clear how well these lessons apply to Arctic shelves, particularly regions influenced by landfast ice.

Landfast ice, which covers the innermost Alaskan Beaufort shelf from October to June, is anchored at the coast along the 2 m isobath and extends offshore to the 20-40 m isobath, covering 25% of the total shelf area. In the absence of landfast ice, currents are swift (20-100 cm/s) and both currents and sea level are coherent with one another and with the local winds. When landfast ice is present, recent MMS studies have shown that the under-ice currents are weak (< 5 cm/sec), variable, and uncorrelated with winds and sea level. Thus landfast ice (but not moving pack ice) inhibits momentum transfer from wind to water. This presumably results in an abrupt transition in surface stress at the transition between landfast and pack ice. Although there are no observations of this transition region, the physics should force an along-shore ice edge jet and a cross-shelf circulation cell. The direction of the ice edge jet, east or west along the Beaufort coast would depend on the water depth at the landfast ice edge.

Objectives The overall goal of this study is to better understand the physical processes controlling circulation in the landfast ice zone of arctic shelves when forced by winds and buoyancy and subjected to various parameterizations of ice-water stress.

Methods This is a modeling study. Using the Regional Ocean Model System, the under-ice circulation responses to the following forcing will be determined:

1. Along- and cross-shelf wind stress patterns offshore of the landfast ice zone,
2. Along-shore flows imposed at the eastern or western edges of the modeling domain,
3. River inflow introduced at the coastal boundary without ambient stratification, and
4. River inflow introduced at the coastal boundary with ambient stratification.

The responses to the forcings above will be examined subject to the following landfast ice-water stress scenarios:

1. No stress
2. Spatially constant stress
3. Stress that increases linearly in the offshore direction out to the landfast ice edge, and
4. Spatially random stress.

Current Status: Model simulations and data analyses to determine the circulation response to wind stress are nearly complete. A poster describing results from these simulations is being presented at the Ocean Sciences Meeting in Orlando, Florida in March, 2008.

Final Report Due: September 2009

Publications Completed: None

Affiliated WWW Sites: http://www.mms.gov/alaska/

Revised Date: March 2008